improperly designed chiller can remove NO\textsubscript{2} from the sample. If a chiller is used without an NO\textsubscript{2}-to-NO converter upstream, it could remove NO\textsubscript{2} from the sample prior NO\textsubscript{X} measurement. 

(c) **System requirements.** A chiller must allow for measuring at least 95% of the total NO\textsubscript{X} at the maximum expected concentration of NO\textsubscript{X}.

(d) **Procedure.** Use the following procedure to verify chiller performance:

1. **Instrument setup.** Follow the analyzer and chiller manufacturers’ start-up and operating instructions. Adjust the analyzer and chiller as needed to optimize performance.

2. **Equipment setup and data collection.** (i) Zero and span the total NO\textsubscript{X} gas analyzer(s) as you would before emission testing.

(ii) Select an NO\textsubscript{2} calibration gas, balance gas of dry air, that has an NO\textsubscript{2} concentration within ±25% of the maximum NO\textsubscript{2} concentration expected during testing.

(iii) Overflow this calibration gas at the gas sampling system’s probe or overflow fitting. Allow for stabilization of the total NO\textsubscript{X} response, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of recorded total NO\textsubscript{X} data and record this value as \(x\text{NOxref}\).

(v) Stop flowing the NO\textsubscript{2} calibration gas.

(vi) Next saturate the sampling system by overflowing a dewpoint generator’s output, set at a dewpoint of 50 °C, to the gas sampling system’s probe or overflow fitting. Sample the dewpoint generator’s output through the sampling system and chiller for at least 10 minutes until the chiller is expected to be removing a constant rate of water.

(vii) Immediately switch back to overflowing the NO\textsubscript{2} calibration gas used to establish \(x\text{NOxref}\). Allow for stabilization of the total NO\textsubscript{X} response, accounting only for transport delays and instrument response. Calculate the mean of 30 seconds of recorded total NO\textsubscript{X} data and record this value as \(x\text{NOxmean}\).

(viii) Correct \(x\text{NOxmean}\) to \(x\text{NOxdry}\) based upon the residual water vapor that passed through the chiller at the chiller’s outlet temperature and pressure.

(3) **Performance evaluation.** If \(x\text{NOxdry}\) is less than 95% of \(x\text{NOxref}\), repair or replace the chiller.

(e) **Exceptions.** The following exceptions apply:

1. You may omit this verification if you can show by engineering analysis that for your NO\textsubscript{X} sampling system and your emission calculations procedures, the chiller always affects your brake-specific NO\textsubscript{X} emission results by less than 0.5% of the applicable NO\textsubscript{X} standard.

2. You may use a chiller that you determine does not meet this verification, as long as you try to correct the problem and the measurement deficiency does not adversely affect your ability to show that engines comply with all applicable emission standards.

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§ 1065.378 NO\textsubscript{2}-to-NO converter conversion verification.

(a) **Scope and frequency.** If you use an analyzer that measures only NO to determine NO\textsubscript{X}, you must use an NO\textsubscript{2}-to-NO converter upstream of the analyzer. Perform this verification after installing the converter, after major maintenance and within 35 days before an emission test. This verification must be repeated at this frequency to verify that the catalytic activity of the NO\textsubscript{2}-to-NO converter has not deteriorated.

(b) **Measurement principles.** An NO\textsubscript{2}-to-NO converter allows an analyzer that measures only NO to determine total NO\textsubscript{X} by converting the NO\textsubscript{2} in exhaust to NO.

(c) **System requirements.** An NO\textsubscript{2}-to-NO converter must allow for measuring at least 95% of the total NO\textsubscript{X} at the maximum expected concentration of NO\textsubscript{2}.

(d) **Procedure.** Use the following procedure to verify the performance of a NO\textsubscript{2}-to-NO converter:

1. **Instrument setup.** Follow the analyzer and NO\textsubscript{2}-to-NO converter manufacturers’ start-up and operating instructions. Adjust the analyzer and converter as needed to optimize performance.

2. **Equipment setup.** Connect an ozonator’s inlet to a zero-air or oxygen source and connect its outlet to one port of a three-way tee fitting. Connect an NO span gas to another port, and
connect the NO₂-to-NO converter inlet to the last port.

(3) Adjustments and data collection. Perform this check as follows:

(i) Set ozonator air off, turn ozonator power off, and set the analyzer to NO mode. Allow for stabilization, accounting only for transport delays and instrument response.

(ii) Use an NO concentration that is representative of the peak total NOX concentration expected during testing. The NO₂ content of the gas mixture shall be less than 5% of the NO concentration. Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NOref}} \).

(iii) Turn on the ozonator \( \text{O}_2 \) supply and adjust the \( \text{O}_2 \) flow rate so the NO indicated by the analyzer is about 10 percent less than \( x_{\text{NOref}} \). Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NO}+\text{O}_2\text{mix}} \).

(iv) Switch the ozonator on and adjust the ozone generation rate so the NO measured by the analyzer is 20 percent of \( x_{\text{NOref}} \), while maintaining at least 10 percent unreacted NO. Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NOmeas}} \).

(v) Switch the \( \text{NOX} \) analyzer to \( \text{NOX} \) mode and measure total \( \text{NOX} \). Record the concentration of \( \text{NOX} \) by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NOXmeas}} \).

(vi) Switch off the ozonator \( \text{O}_2 \) supply. The \( \text{NOX} \) analyzer will indicate the \( \text{NOX} \) in the original NO-in-N₂ mixture. Record the concentration of \( \text{NOX} \) by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NOXref}} \). This value should be no more than 5 percent above the \( x_{\text{NOref}} \) value.

(vii) Turn off the ozonator \( \text{O}_2 \) supply. The \( \text{NOX} \) analyzer will indicate the \( \text{NOX} \) in the original NO-in-N₂ mixture. Record the concentration of \( \text{NOX} \) by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as \( x_{\text{NOXmix}} \). This value should be no more than 5 percent above the \( x_{\text{NOXref}} \) value.

(4) Performance evaluation. Calculate the efficiency of the \( \text{NOX} \) converter by substituting the concentrations obtained into the following equation:

\[
\text{efficiency} = \left(1 + \frac{x_{\text{NOXmeas}} - x_{\text{NOX}+\text{O}_2\text{mix}}}{x_{\text{NO}+\text{O}_2\text{mix}} - x_{\text{NOmeas}}} \right) \cdot 100\%
\]

(5) If the result is less than 95%, repair or replace the NO₂-to-NO converter.

(e) Exceptions. The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis that for your \( \text{NOX} \) sampling system and your emission calculations procedures, the converter always affects your brake-specific \( \text{NOX} \) emission results by less than 0.5% of the applicable \( \text{NOX} \) standard.

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